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NAPPN Annual Conference Abstract:

Limitations of Solar-Induced Chlorophyll Fluorescence (SIF) for Estimating Photosynthesis Under Stress

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High-throughput measurements of photosynthesis of plants grown under various conditions may provide important insights into the plasticity of the photosynthetic performance of plants. Remote sensing of photosynthetic activity [i.e., solar-induced chlorophyll fluorescence (SIF)] and its derivatives are the next generation of remote techniques, enabling high-throughput photosynthesis measurements under field conditions. We hypothesized that by measuring SIF simultaneously with measurements of whole-plant water relations in a standardized controlled drought experiment, we would be able to quantify photosynthetic activity and to detect water stress at an early stage. A functional-phenotyping platform was used to apply the controlled drought treatment and to monitor the growth and water balance of tomato introgression lines (ILs). A new SIF-derived index, electron transport rate (RS-ETRi), was found to be negatively correlated with whole-plant stomatal conductance (Gsc) under non-stressed conditions; whereas a positive correlation was observed between those factors under drought stress. No significant relationships were found between SIF and plant biomass or Gsc. SIF 687 responded to drought earlier than any of the other measured vegetation indices (VIs). SIF parameters could not differentiate between IL lines; whereas differences between ILs were clearly identified by the gravimetric water-relations measurements. We concluded that SIF did not provide any advantage over commonly used methods for detecting physiological differences between the ILs. Overall, although SIF plays a significant role in photosynthesis, the relationship between SIF and photosynthesis is complex and we believe it would be an oversimplification to use SIF to quantify photosynthetic activity.